

Metal and Quality, LLC
CERTIFICATE OF ANALYSIS
DSZU C091 – DSZU C093
Maraging Steels



INFORMATION

Certified Reference Material DSZU C091 – DSZU C093 is intended for calibration of measuring instruments at definition of chemical composition of maraging steels using optical emission and X-ray spectrometry methods

CERTIFIED VALUES, mass fraction in %

		Ni	Co	Mo	Ti	Cr	Mn	C	Si	Al	S	P	Cu
C091	Certified M(M)	18.23	8.19	5.04	0.81	0.120	0.090	0.035	0.090	0.050	<i>0.011</i>	<i>0.006</i>	<i>0.12</i>
	Uncertainty C(95%)	0.12	0.09	0.06	0.02	0.008	0.007	0.001	0.007	0.008	<i>0.002</i>	<i>0.001</i>	<i>0.02</i>
C092	Certified M(M)	20.09	5.27	5.59	<i>0.009</i>	0.23	0.274	0.015	0.101	<i>0.004</i>	<i>0.0090</i>	<i>0.006</i>	<i>0.16</i>
	Uncertainty C(95%)	0.16	0.13	0.10	<i>0.002</i>	0.01	0.008	0.002	0.010	<i>0.001</i>	<i>0.0015</i>	<i>0.001</i>	<i>0.02</i>
C093	Certified M(M)	15.81	12.14	3.79	1.56	0.42	0.318	0.013	0.099	0.166	<i>0.0071</i>	<i>0.006</i>	<i>0.12</i>
	Uncertainty C(95%)	0.15	0.15	0.07	0.03	0.02	0.009	0.002	0.009	0.008	<i>0.0014</i>	<i>0.002</i>	<i>0.02</i>

Uncertainty C(95%) estimated as the half-width confidence interval of Student's t-distribution, when n is the number of laboratory means (see next page)

$$C(95\%) = \frac{t \cdot s(M)}{\sqrt{n}}$$

Italics – indicative values

SPECIFICATION

Reference materials in the form of cylinders diameter of 40 - 42 mm, height 17 - 18 mm, are made of forged steel which been smelted in vacuum induction furnace

HOMOGENEITY

The homogeneity was evaluated according to ISO Guide 35:2006 (7.7. Evaluating a homogeneity study) by OES and XRF methods and was found to be acceptable

TRACEABILITY

The characterization of DSZU C091 – DSZU C093 was achieved through inter-laboratory experiment. Chemical analyses were carried out by the participants on both monolithic samples and on chips taken from monolithic samples. Participating laboratories followed the requirements of ISO 17025 and used standardized analytical methods and certified reference materials

RELEASE DATE

November 2015

VALIDITY

These CRMs have no expiration date. The reference materials will remain stable provided they are not exposed to excessive heat, such as during work surface preparation

SAFETY

A Safety Data Sheet (SDS) is not required for these reference materials. Material and packing does not contain hazardous chemical, explosives and radioactive substances and substances which might influence health and the environment

PARTICIPATING LABORATORIES

Dnepropetsstal (DSS) OJSC, Ukraine
 Institute for Ferrous Metallurgy (IMZ), Poland
 TCR Engineering Services, India
 Metal and Quality PJSC, Ukraine
 Ukrainian Special Steels Institute (USSI)
 ENVIFORM a.s., Czech Republic
 LECO European Technical Centre Prague, Czech Republic
 SPL Bohumín, Czech Republic
 Vítkovice Testing Center s.r.o., Czech Republic
 ŽDAS a.s., Czech Republic

CONTACTS

37 Nezalezhnoi Ukrain Street, Zaporozhye city 69019, Ukraine
 Tel/fax: +380 61 7171800
<https://rm.co.ua> rm@rm.co.ua

MEAN VALUES OF LABORATORIES

C091

n	Ni	Co	Mo	Ti	Cr	Mn	C	Si	Al	S	P	Cu
1	17.94	7.90	4.85	0.770	0.100	0.074	0.032	0.075	0.040	0,0080	0.005	0.089
2	17.97	8.03	4.89	0.773	0.105	0.076	0.033	0.080	0.043	0,0090	0.005	0.092
3	17.99	8.09	4.95	0.780	0.110	0.077	0.034	0.089	0.043	0,0091	0.006	0.099
4	18.10	8.12	5.00	0.800	0.115	0.089	0.035	0.090	0.044	0,0110	0.006	0.107
5	18.16	8.12	5.00	0.800	0.116	0.090	0.036	0.091	0.047	0,0110	0.007	0.140
6	18.19	8.21	5.03	0.810	0.116	0.092	0.036	0.094	0.050	0,0120	0.007	0.146
7	18.23	8.25	5.05	0.810	0.120	0.096	0.036	0.099	0.060	0,0120		0.147
8	18.23	8.26	5.07	0.810	0.120	0.097	0.037	0.100	0.070	0,0160		0.159
9	18.26	8.30	5.09	0.820	0.123	0.100	0.037					
10	18.38	8.30	5.10	0.827	0.133	0.100						
11	18.48	8.30	5.10	0.830	0.138	0.103						
12	18.49	8.38	5.10	0.830	0.140							
13	18.51		5.18	0.840								
14			5.19	0.853								
15				0.870								
M(M)	18.23	8.19	5.04	0.815	0.120	0.090	0.035	0.090	0.050	0,0110	0.006	0.12
s(M)	0.20	0.14	0.10	0.028	0.012	0.010	0.002	0.009	0.008	0,0025	0.001	0.03

C092

n	Ni	Co	Mo	Ti	Cr	Mn	C	Si	Al	S	P	Cu
1	19.79	4.94	5.34	0.006	0.198	0.260	0.012	0.080	0.003	0.0070	0.005	0.129
2	19.79	4.95	5.40	0.008	0.210	0.260	0.012	0.095	0.004	0.0070	0.005	0.130
3	19.80	5.00	5.43	0.008	0.220	0.263	0.013	0.100	0.004	0.0086	0.006	0.138
4	19.90	5.18	5.45	0.009	0.220	0.270	0.014	0.100	0.005	0.0090	0.006	0.139
5	20.03	5.28	5.49	0.010	0.226	0.274	0.015	0.110		0.0092	0.007	0.155
6	20.12	5.28	5.61	0.010	0.227	0.277	0.015	0.110		0.0110	0.007	0.170
7	20.19	5.30	5.63	0.012	0.230	0.277	0.017	0.110		0.0110		0.190
8	20.25	5.35	5.70		0.238	0.280	0.017					0.190
9	20.34	5.39	5.72		0.240	0.290	0.019					
10	20.34	5.40	5.75		0.249	0.292						
11	20.43	5.54	5.77		0.254							
12		5.57	5.83		0.260							
M(M)	20.09	5.27	5.59	0.009	0.231	0.274	0.015	0.101	0.004	0.0090	0.006	0.16
s(M)	0.24	0.21	0.16	0.002	0.018	0.011	0.002	0.011	0.001	0.0016	0.001	0.03

C093

n	Ni	Co	Mo	Ti	Cr	Mn	C	Si	Al	S	P	Cu
1	15.40	11.98	3.55	1.46	0.380	0.292	0.010	0.080	0.151	0.0040	0.005	0.090
2	15.53	11.99	3.55	1.48	0.383	0.297	0.011	0.089	0.157	0.0069	0.005	0.090
3	15.55	12.00	3.67	1.50	0.400	0.310	0.012	0.095	0.160	0.0070	0.005	0.098
4	15.56	12.03	3.74	1.51	0.400	0.311	0.013	0.100	0.160	0.0071	0.005	0.101
5	15.62	12.05	3.75	1.53	0.407	0.314	0.013	0.100	0.167	0.0080	0.008	0.132
6	15.70	12.09	3.75	1.54	0.420	0.316	0.014	0.106	0.173	0.0080	0.008	0.135
7	15.72	12.10	3.80	1.54	0.440	0.320	0.015	0.110	0.173	0.0090		0.138
8	15.80	12.10	3.80	1.56	0.446	0.322	0.015	0.110	0.177			0.138
9	15.85	12.19	3.81	1.59	0.450	0.327	0.016		0.180			
10	15.89	12.30	3.83	1.59	0.458	0.330						
11	15.90	12.75	3.84	1.60		0.338						
12	15.98		3.90	1.63		0.340						
13	16.00		3.90	1.63								
14	16.18		3.97	1.64								
15	16.41		3.98									
M(M)	15.81	12.14	3.79	1.56	0.418	0.318	0.013	0.099	0.166	0.0071	0.006	0.12
s(M)	0.27	0.22	0.13	0.06	0.029	0.015	0.002	0.010	0.010	0.0016	0.002	0.02

M(M) - Mean of intralaboratory means

s(M) - Standard deviation of the mean values of laboratories

THE METHODS USED

Ni - Photometric, ICP-OES, XRF, Spark OES, OES-GDS

Co - AAS, ICP-OES, XRF, Spark OES, OES-GDS

Mo - Photometric, AAS, ICP-OES, XRF, Spark OES, OES-GDS

Ti - Photometric, AAS, ICP-OES, XRF, Spark OES, OES-GDS

Cr - Photometric, ICP-OES, XRF, Spark OES, OES-GDS

Mn - Photometric, ICP-OES, XRF, Spark OES, OES-GDS

C - HFIR, Coulometric, Spark OES

Si - Photometric, Spark OES, OES-GDS, XRF

Al - AAS, Spark OES, OES-GDS, XRF

S - HFIR, Coulometric, Spark OES

P - Spark OES, XRF

Cu - AAS, Spark OES, OES-GDS, XRF